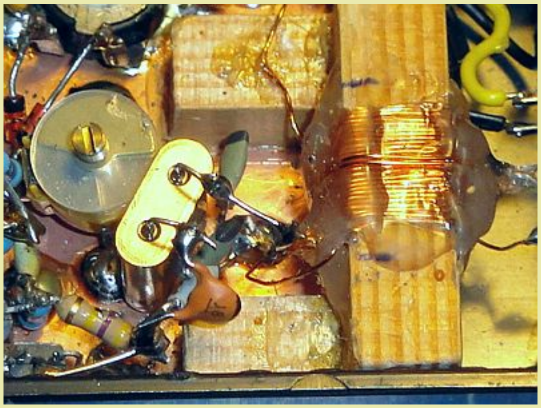
CRYSTAL FILTER FOR THE 30 METER QRSS BEACON RECEIVERS

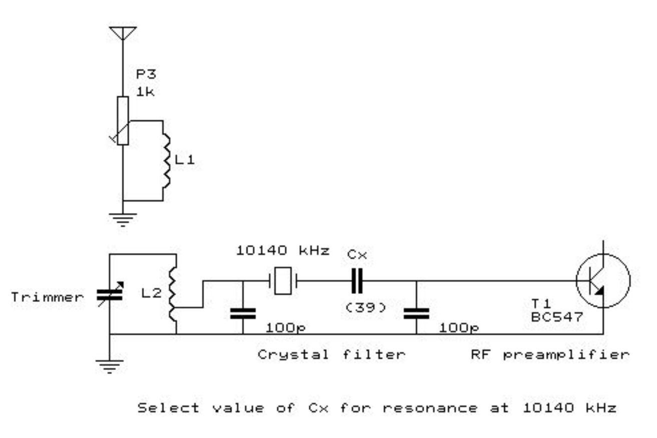
(2011)

KLIK HIER VOOR DE NEDERLANDSE VERSIE



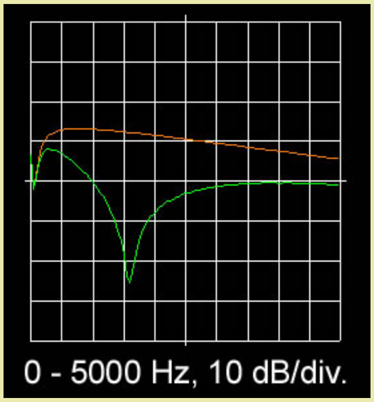
The crystal filter with 1 crystal is placed between the antenna coil and the RF preamplifier.

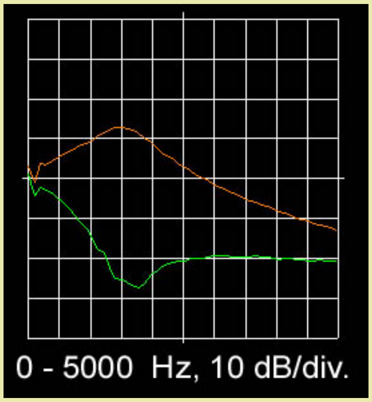
Crystal filter for the 30 meter QRSS beacon receivers
Two direct conversion receivers were made for the reception of QRSS beacon transmitters in the band 10140.0 kHz to 10140.1 kHz in de 30 meter amateurband. One with- and one without side band suppression with use of the phase method. During the evenings, these simple receivers had some problems with AM detection of strong broadcast stations and overloading due to strong radio stations near the reception frequency. Then the RF attenuator (potentiometer P3) has to be used, but that reduces the sensitivity of the receiver. By adding this simple crystal filter with only one crystal, the AM detection and overloading of the receiver do not occur anymore. Thanks to Johan, PA0TAB, who mounted a similar crystal filter in his receiver and who told me where the difficult obtainable crystals could be bought. At the local electronic parts shop for 3.65 Euro!

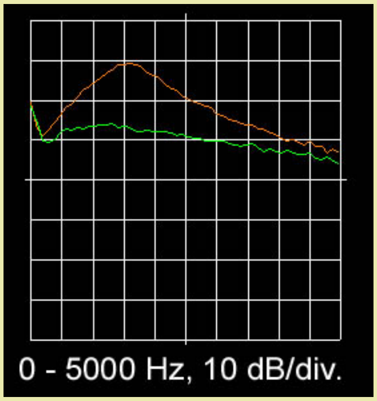


The diagram of the crystal filter, that is inserted between the antenna coil and the RF preamplifier.

The crystal filter
The capacitor of 1 nF between L2 and T1 has been replaced by a simple crystal filter with 1 crystal of 10140 kHz, a series capacitor Cx and two capacitors of 100 pF to ground. The value of the capacitor Cx is chosen for resonance at 10140 kHz. For my crystal, 33 pF was too small (resonance frequency too high) and 47 pF too large (resonance peak too low). As I did not have a capacitor of 39 pF anymore, a capacitor of 18 pF and one of 22 pF were connected in parallel for a Cx value of 40 pF.







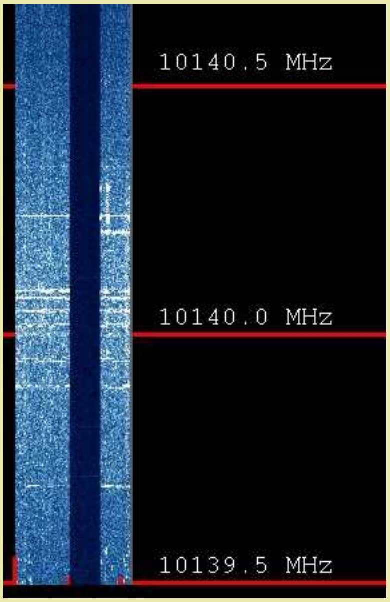
Receiver with side band suppression without crystal filter

Receiver with side band suppression with crystal filter

Receiver without side band suppression with crystal filter

Frequency characteristic (orange line) and side band suppression (difference between orange and green line).
The reception frequency of 10140 kHz lies at the audio frequency of 1550 Hz in the graph.

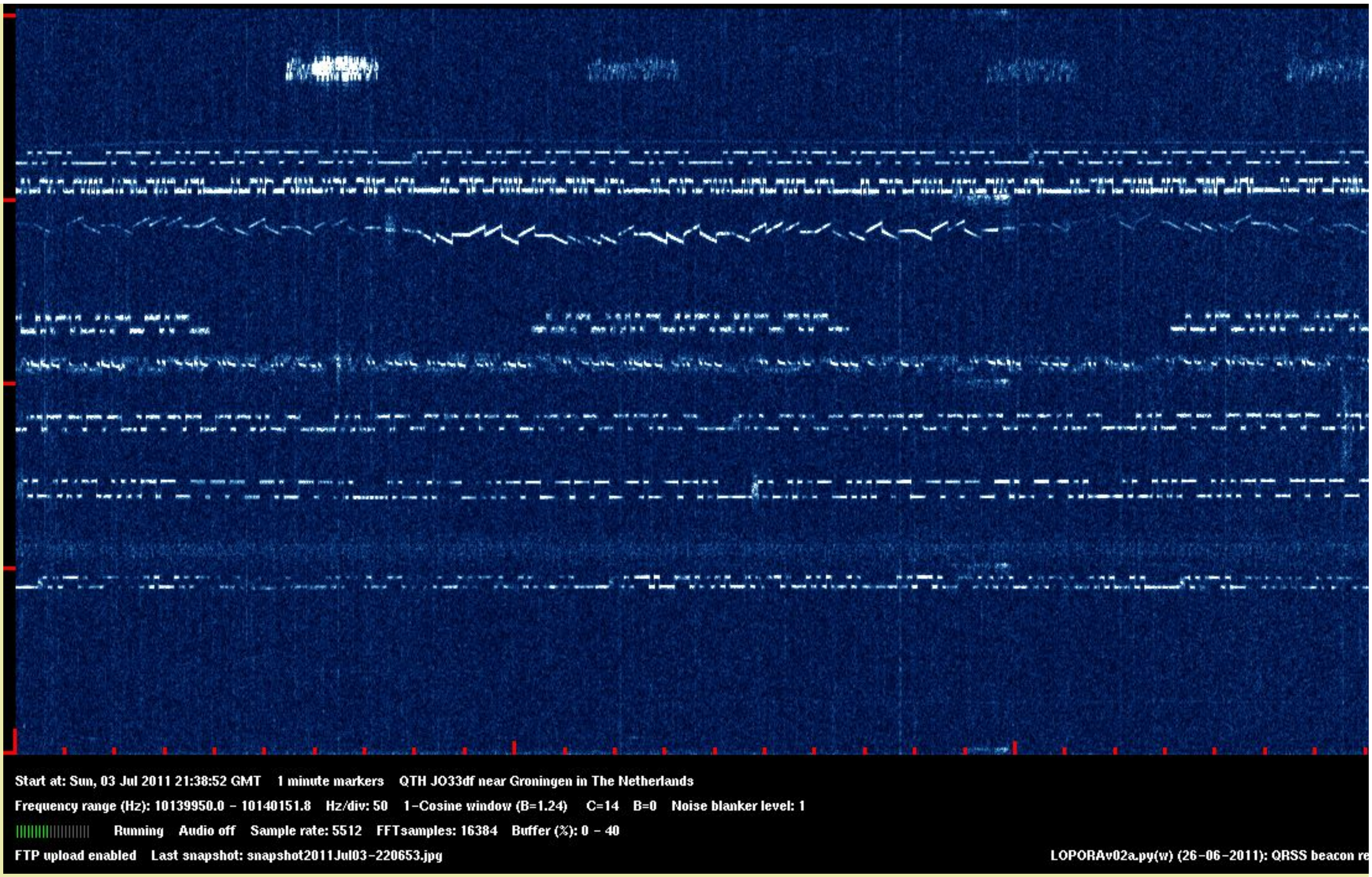
The improvement
The crystal filter is approximately 800 Hz wide. Wide enough to receive also WSPR signals between 10140.1 kHz and 10140.3 kHz. Strong signals outside the bandwidth of this very simple crystal filter are upto 30 dB attenuated! The AM detection of strong broadcast transmitters and also overloading of strong signals near the reception frequency are completely gone. The RF attenuator (the potentiometer P3 of 1k ohm at the input) does not have to be used anymore.
Also the side band suppression is better. Even the simple receiver without side band suppression, does already have a suppression of 18 dB of the unwanted side band due to the simple crystal filter and with this filter, it will perform nearly as good as much more expensive receivers.



The spectrum. The noise peaks at 10140 kHz. When disconnecting the antenna, you can see a dark strip in the spectrum. So the own noise of the receiver is really low.

Picture of the spectrum
The sensitivity of the receiver is excellent. You can see that on the picture here above of the spectrum. When the antenna is disconnected, you can see a dark strip in the spectrum, as the noise almost disappears. The noise of the receiver is almost negligible. In fact, the sensitivity is too good. Some RF attenuation is adviceable to increase the dynamic range. On the picture, you can also see that the filter peaks on 10140 kHz. At this frequency, the noise is maximal. With use of such a spectrum picture, you can easily determine the correct value of Cx.

Omnidirectional reception antenna.



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Start at: Sun, 03 Jul 2011 21:38:52 GMT    1 minute markers    QTH JO33df near Groningen in The Netherlands
Frequency range (Hz): 10139950.0 - 10140151.8    Hz/div: 50    1-Cosine window (B=1.24)    C=14    B=0    Noise blanker level: 1
               Running    Audio off    Sample rate: 5512    FFTsamples: 16384    Buffer (%): 0 - 40
FTP upload enabled    Last snapshot: snapshot2011Jul03-220653.jpg                                    LOPORAv02a.py(w) (26-06-2011): QRSS beacon re
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And just a picture of reception results with the receiver with crytal filter and the QRSS beacon reception program LOPORA (LOw POwer RAdio), written in the programming languate Python.

QRSS links:
Simple QRSS receiver without side band suppression
Simple QRSS receiver with side band suppression according to the phase method
Grabber for reception results of QRSS beacons

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